modem frame and OFDM modulated to produce a DAB baseband signal. Diversity delay is introduced in the analog AM path and passed through the station's existing analog audio processor and band limited to 5 kHz. The processed analog audio is summed with the digital carriers in the IBOC exciter. This baseband signal is converted to magnitude ρ and phase ϕ for amplification in the station's existing analog transmitter.[9]

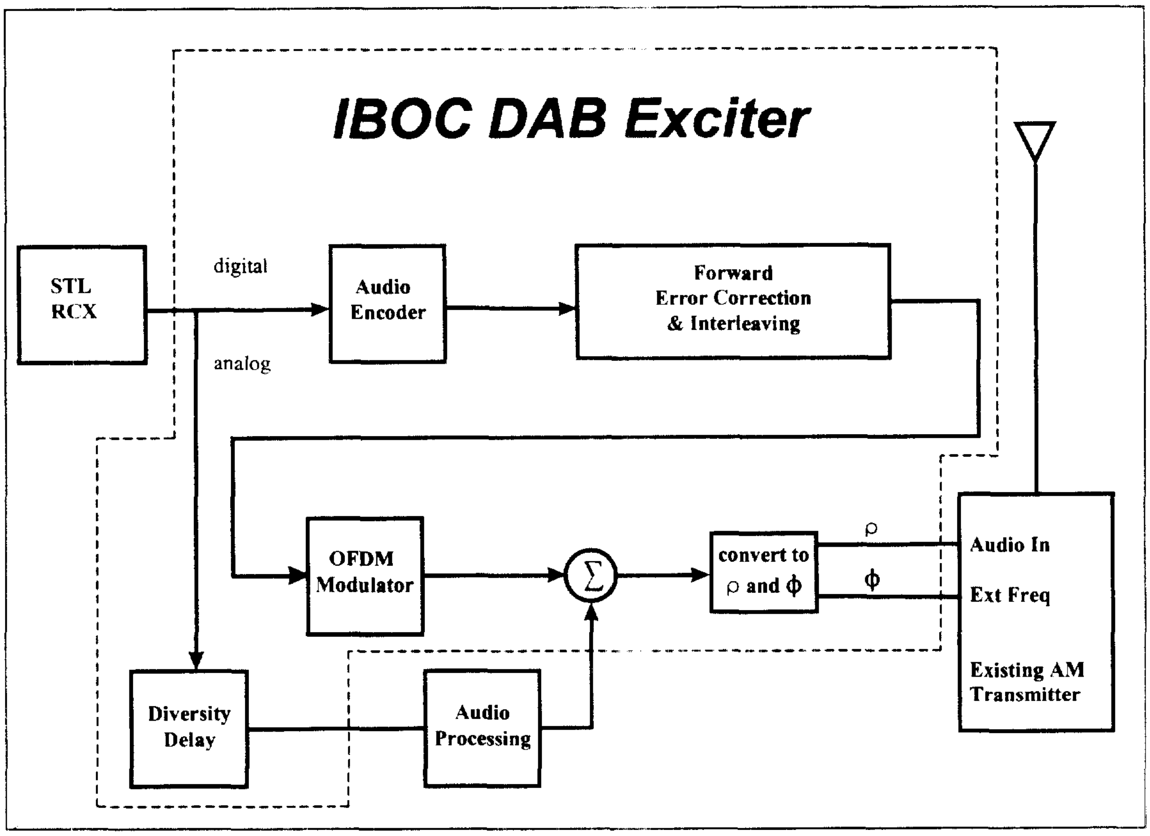

Figure F-3 – Hybrid AM IBOC Transmitter Block Diagram

It is unlikely that any tube-type or first-generation pulse-duration modulation ("PDM") transmitters will have noise, frequency response, and distortion performance specifications sufficient to reproduce an IBOC hybrid or all-digital waveform. However, some currently

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[9] Details such as data insertion and synchronization have been omitted here for simplicity.

produced solid state AM analog transmitters are capable of transmitting the IBOC waveform. USADR has many hours of on-air experience using a current production amplitude modulated transmitter for IBOC DAB transmission.

Cost of station conversion is dictated by the suitability of the current transmitter. Absent the replacement of the transmitter, the station needs only to purchase an IBOC exciter and possibly a replacement studio transmitter link if it has insufficient noise performance and dynamic range.

A functional diagram of the AM IBOC all-digital transmitter is presented in Figure F-4. The audio input simultaneously feeds the main channel audio encoder and the diversity delay. The signal then follows two identical paths and is encoded with the FEC block code and interleaved. The resulting bit streams are combined into a modem frame and OFDM modulated to produce a DAB baseband signal.

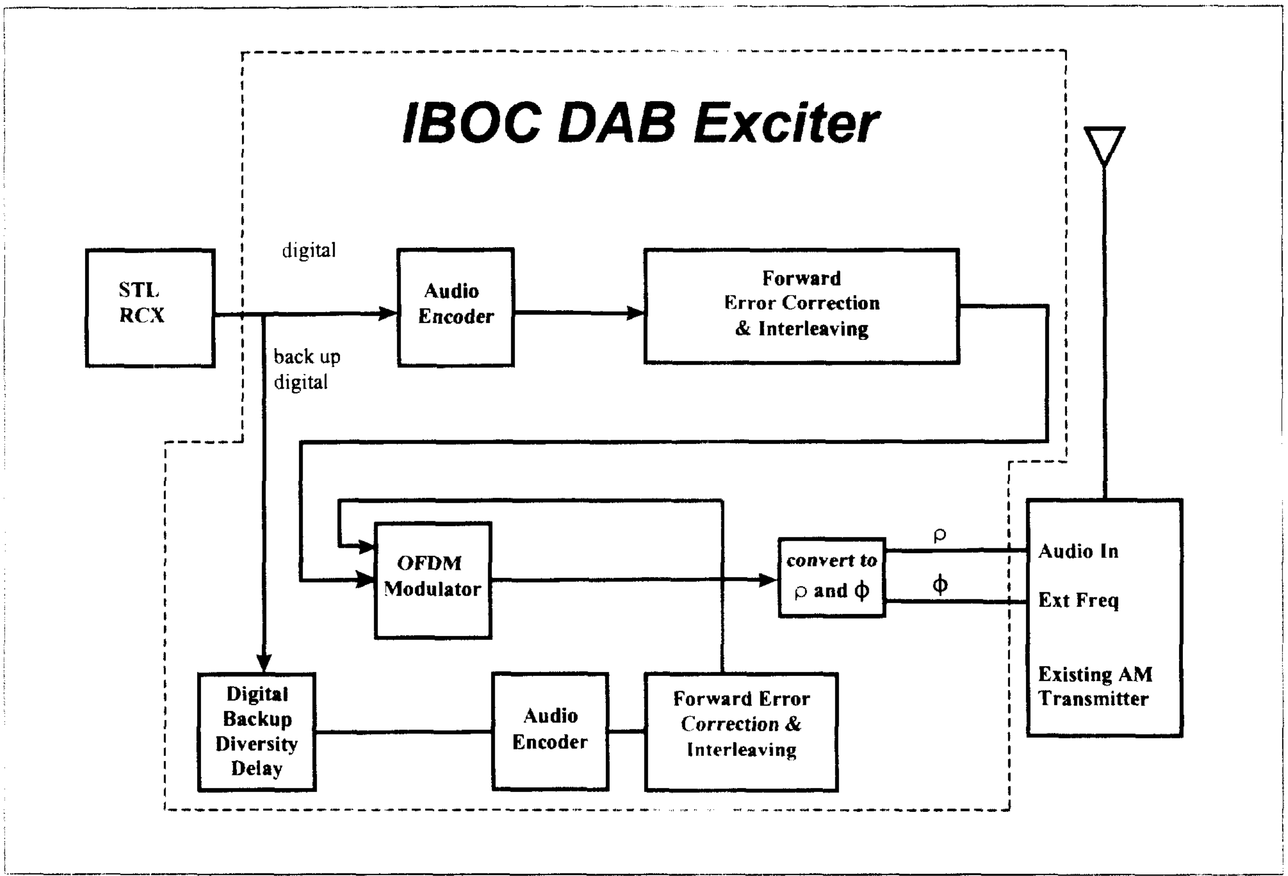

Figure F-4 -All-Digital AM IBOC Transmitter Block Diagram

IV. <u>Reception of the IBOC DAB Signal</u>

A functional block diagram of an AM IBOC receiver is presented in Figure F-5. The signal is received by a conventional RF front end and converted to IF, in a manner similar to existing analog receivers. Unlike typical analog receivers, however, the signal is filtered, A/D converted at IF, and digitally downconverted to baseband in-phase and quadrature signal components. The hybrid signal is then split into analog and DAB components. The analog component is then demodulated to produce a digitally sampled audio signal. The DAB signal is synchronized and demodulated into symbols. These symbols are deframed for subsequent deinterleaving and FEC decoding. The resulting bit stream is processed by the audio decoder to produce the digital stereo DAB output. This DAB audio signal is delayed by the same amount of time as the analog signal was delayed at the transmitter. The audio blend function blends the digital signal to the analog signal if the digital signal is corrupted and is also used to quickly acquire the signal during tuning or reacquisition.

Noise blanking is an integral part of the IBOC receiver and is used to improve digital and analog reception. Receivers use tuned circuits to filter out adjacent channels and intermodulation products. These tuned circuits tend to "ring", or stretch out short pulses into longer interruptions. A noise blanker senses the impulse and turns off the RF stages for the short duration of the pulse, effectively limiting its effect. Short pulses have a lesser effect on the digital data stream and increase "listenability" during times of analog reception [10]

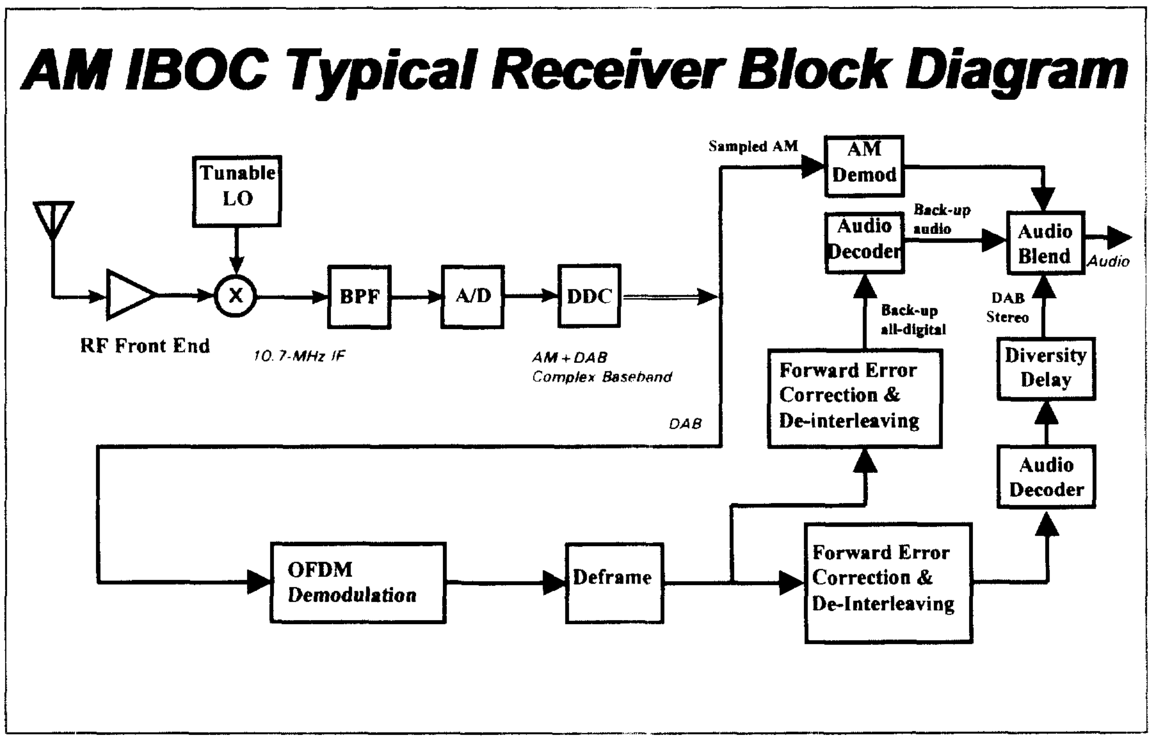

Figure F-5 - AM IBOC Typical Receiver Block Diagram

10 The data paths and the noise blanker circuit are not shown for simplicity.

For all-digital signals, a low rate digital back-up channel path is shown with its own FEC. After deframing, the signal passes through a shorter interleaver with error correction. It is then applied to its audio decodec for use in the blend circuit

A physical block diagram of an AM/FM IBOC receiver is presented in Figure F-6. The analog front end and analog to digital conversion functions of Figure 5 are mapped to Figure F-6. However, the direct digital down-conversion to baseband, the AM/DAB split, analog AM demodulation, and the DAB processing (including the OFDM demodulator, FEC coding and interleaving, codec, and blend functions) are all performed by the DSP chipset.[11]

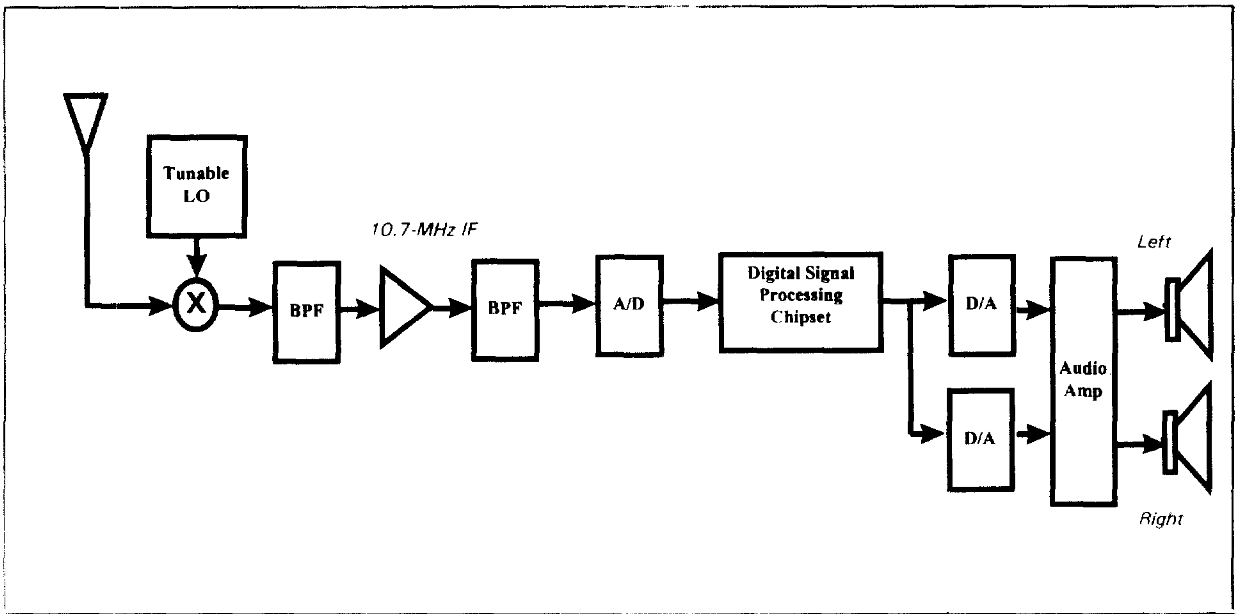

Figure F-6 - AM/FM IBOC Receiver Physical Block Diagram

Although the front end of the IBOC DAB receiver may be similar to that of an existing analog radio, the remainder of the IBOC DAB receiver will differ in some important respects. First, the IBOC receiver performs IF digitization and direct digital down-conversion of the received signal. Although not widespread, this approach is currently being used in some

[11] For simplicity the data channel and noise blanker have been omitted.

consumer analog radios. The USADR IBOC receiver will leverage this development to minimize cost. Second, the USADR receiver will perform its DAB processing in a digital signal processing chipset. The chipset decodes analog AM and FM and DAB AM and FM in both the hybrid and all-digital modes. This chipset replaces a single-chip AM/FM demodulator that is common in many radios.

Affordable receiver implementation is also realized through integration of the AM and FM receive paths, which allows maximum duplication of receiver circuitry for both the AM and FM modes. Additionally, digital receiver technology makes possible many features that are too expensive to implement by using discrete components prevalent in today's receiver designs. Thus, IBOC DAB receivers leverage digital techniques to bring a new listening experience for digital as well as for analog stations. Enhancements possible as a result of digital receiver implementation include coherent analog AM detection to reduce distortion (such as the "Donald Duck" sound) under fading conditions and during reception within the nulls of a directional array. Reception is further enhanced through digital IF filtering, which extends the high frequencies and eliminates first adjacent analog interference and its 10 kHz carrier birdie, and a noise blanker to reduce impulsive noise.

Because most of the receiver functions are performed by the DAB chipset, AM IBOC DAB radio can be integrated with FM IBOC radio with virtually no additional circuitry (other than that required by the receiver front end). Therefore, the superior quality and performance of IBOC receivers, together with their auxiliary services, will provide consumers with an alternative to existing analog radio. Increased sophistication will initially drive the cost of IBOC receivers higher than their analog counterparts. Eventually, as the technology matures, the cost should decrease to a point where it is comparable to that of a moderately priced analog receiver. The consumer will decide at what point the additional value outweighs the increased cost.

Appendix G

ENGINEERING REPORT

STUDY OF PRESENT ANALOG INTERFERENCE AND THE IMPACT OF ADDING IBOC TO THE AM BAND

October 1998

A Joint Venture of

Glen Clark & Associates
Pittsburgh, Pennsylvania

and

DuTreil, Lundin & Rackley, Inc.
Sarasota, Florida

Executive Summary

USA Digital Radio has retained the consulting engineering firms of Glen Clark & Associates of Pittsburgh, Pennsylvania and duTreil, Lundin & Rackley of Sarasota, Florida, to characterize the existing AM environment.

This report presents results of studies of the interference environment in the AM band. The study determines the existing levels of analog interference and the effects of adding digital information to the analog band. Specifically, this analysis characterizes the extent of analog existing co- and adjacent-channel interference in the AM band during daytime & nighttime conditions. It then discusses the issues faced by IBOC DAB while operating in this environment.

The information developed and presented in this study was based on an examination of 101 radio stations using FCC propagation models. The study used the resulting signal levels to determine signal to noise ratios in a typical AM receiver when receiving current analog broadcasts. Hybrid IBOC analog broadcasts were substituted for the analog broadcast and the resulting signal to noise ratios determined.

Based on this analysis in most cases, the existing analog service will not be perceptibly affected by the commencement of IBOC broadcasting. We believe that the proposed digital IBOC transmission will have no significant impact on the analog coverage areas of existing AM broadcast stations.

Glen T. Clark, P.E.

Ronald D. Rackley, P.E

Scott E. Metker, PhD

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STUDY OF PRESENT ANALOG INTERFERENCE AND THE IMPACT OF ADDING IBOC TO THE AM BAND

I. INTRODUCTION

USADR has retained the consulting engineering firms of Glen Clark & Associates of Pittsburgh, Pennsylvania and duTreil, Lundin & Rackley of Sarasota, Florida to prepare a report analyzing (1) the current interference environment in the AM band and (2) the impact of the addition of IBOC transmissions on present analog receivers.

II. SCOPE OF STUDIES

This study was undertaken to provide USA Digital Radio with information about the existing interference levels in the AM band. The study also examined interference levels in AM analog receivers after the AM band is fully populated with hybrid transmissions.

III. EXISTING CONDITIONS

The AM band is characterized by diverse propagation environments depending on time of day.

A. Daytime AM Propagation

During daylight hours, signals in the AM broadcast band travel via groundwave propagation. The signal sets up an electric field in the earth which propagates outward from the antenna. How far the signal will propagate is a function of the earth's conductivity over the propagation path and the frequency of the transmitted signal. The FCC has adopted a complex model of daytime, AM propagation which is described in Part 73.183 of the Rules and is used for all daytime calculations in this report. A study of the present interference environment for a daytime station includes the groundwave contributions of dozens of distant stations on the same or nearby channels.

B. Nighttime AM Propagation

During nighttime hours, AM signals also propagate via reflections off of upper levels of the atmosphere. Unlike groundwave signals, these "skywave" signals can travel thousands of miles. The FCC skywave model described in Section 73.182(k) through (o) of the Rules was used for all nighttime calculations in this report. A study of the present interference environment for a nighttime station included the skywave *and* groundwave contributions of dozens of distant stations on the same or nearby channels.

IV. METHODOLOGY

In order to obtain useful information for this study it is necessary to compare the current noise environment in the AM band with the noise environment after IBOC DAB is introduced. Since each AM station has a unique interference environment it is important to study multiple AM stations so that there is a representative sample.

To obtain a representative sample, 101 stations were chosen.[1] The population of all AM stations was divided into several subcategories based on the three characteristics: (1) market size, (2) geographic location and (3) FCC allocation class. The stations were partitioned into timezones: Eastern, Central, Mountain and Pacific, and categorized by FCC classifications: Class A, Class B and Class C. Markets were grouped into size classifications of: Market size 1-10, Market size 11-50, Market size 51-100, and market size 101+. There are 48 permutations of these three characteristics.

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[1] *See* Supplement A.

In order to obtain a thorough understanding of the range of conditions included in the present inventory of stations, 72 points around the service contour of each station were evaluated. The first point was at an azimuth of due north and the increment of azimuth was five degrees clockwise. The 72nd point was at an azimuth of 355 degrees. Each station provided data at 72 azimuths for day and 72 azimuths for night. This provided 14,544 total datapoints for the 101 stations.

All daytime facilities were evaluated at the predicted, 2 mV/m groundwave contour. Class A nighttime facilities were also evaluated at the predicted, 2 mV/m groundwave contour. Class B nighttime facilities were evaluated at the predicted, Nighttime Interference Free (N.I.F.) [50% exclusion as defined under FCC Section 73.182(k)] groundwave contour. Class C facilities were evaluated at the predicted, 25 mV/m groundwave contour. When the specified-value contour extended significantly offshore, the contour was manually truncated to a placement near the shore.

Next a computer model of a conventional analog transmitter employing typical audio processing, a hybrid IBOC transmitter, and a typical analog receiver were created. This complete system model[2] enabled the calculation of audio signal-to-noise ratios[3] ("SNR's") found at the speaker terminals[4] for both the current environment and in an IBOC AM environment. The post-

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2 *See* Supplement B for details of the transmitter and receiver models.

3 While RF D/U ratios and audio SNR's are both expressed in dB, it is important to keep in mind that they are not the same quantity and that there is not direct mapping from one to the other.

4 As the non-linear influence of the receiver's detector diode is not completely known, the computer analysis actually compares the SNR of the baseband at the input terminals of the detector diode. However, conceptually, it is more intuitive to think in terms of SNR at the speaker

IBOC SNR was subtracted from the pre-IBOC SNR to determine the net effect of IBOC conversion on SNR. The changes in the audio SNR's are shown in Supplement B.

V. RESULTS

Supplement C shows that there are large differences between the allocations of different stations. More importantly, widely-varying interference conditions exist between allocations, and no two stations have the same interference profile Analysis of the data shows that there is generally some consistency in the amount of co-channel interference which stations receive. Further analysis shows that there is less consistency in the amount of first-adjacent channel interference which stations experience. Where differences arise between stations in how they would be affected by IBOC, it is likely that those differences will be traced to differences in the first-adjacent situations rather than differences in the co-channel situations. This analysis indicates that there are few co-channel issues in implementing IBOC.

Supplement B compares the current analog environment to the environment created by the simultaneous implementation of the 20 kHz hybrid IBOC format. This analysis found that, for daytime operation, the composite SNR for an average receiver would be improved by more than 2 dB for more than 85% of the receiving locations.[5] The composite SNR would be worse for fewer than 7% of the receiving locations during day operation, and at no studied location by more than 2 dB.

For nighttime operation, the composite SNR for an average receiver would be improved by more than 2 dB for more than 50% of the receiving locations. The composite SNR would be

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[5] *See* Supplement B.

worse for fewer than 10% of the receiving locations during night operation, and at no studied location by more than 2 dB.

This information demonstrates that the composite SNR is reduced for the large majority of AM stations by the simultaneous implementation of hybrid IBOC. For those stations which are not improved the increased noise level is slight to imperceptible.

VI. CONCLUSIONS

The implementation of a simultaneous IBOC format on the AM broadcast band would result in negligible impact on the ability of listeners to continue to receive conventional (analog) AM on existing receivers. On an average receiver, the signal-to-noise ratio for analog reception is improved at *significantly* more points than it is harmed. This is true for both the day and night conditions.

SUPPLEMENT A

METHODOLOGY, QUALIFICATIONS AND DERIVATIONS

1) The study was based on the FCC's, AM computer database dated July 14, 1998.

2) All ground conductivities were based on the FCC's presumed conductivities in FCC Figure M-3.

3) Only *licensed* stations were considered when performing the study. *Applications* and *Construction Permits* were not included.

4) All stations were evaluated with operating facilities, even if those facilities include grandfathered operations which do not comply with present allocation standards.

5) No daytime stations were chosen for study. However, the contributions of all relevant daytime stations were included when calculating aggregate, received interference.

6) No foreign stations were chosen for study. However, the contributions of all relevant foreign stations were included when calculating aggregate, received interference.

7) Where sharetime operations are authorized, one of the entries was manually removed so as to not overpredict the interference contribution from that station.

8) A triangular modulation power spectral density (PSD), truncated at f_c +/-10 kHz, was presumed for present, analog broadcasting (See Supplement B).

9) Existing analog broadcasters were presumed to have a modulation density with a time-averaged audio power of 0.1 watt per 1 watt of carrier power.

10) All interfering signals were power-summed to obtain the aggregate interference.

* * * *

SUPPLEMENT B

AUDIO SNR CHANGES CAUSED BY THE ADDITION OF IBOC

Supplement F examined the carrier ratios which were found around the periphery of chosen contours, which is a deterministic analysis That is, no subjective judgment or presumption was required to arrive at the data.[1] Two engineers working independently would arrive at the same numerical data.

This section seeks to expand the analysis to include the entire system, from the transmitter to the speaker.[2] This broader evaluation gives a more complete understanding of how the typical listener would be affected. However, there is a wide variation in the performance and quality of receivers. Expanding the model to include the receiver requires one to make a subjective presumption about the receiver selectivity. The results of this section are a function of that presumption. Changing the receiver presumption would change the data obtained.

We have presumed a response, shown in Figure B-1 and which we believe to be typical, which is a "composite" of a number of receivers which were evaluated in the laboratory. We have also presumed "before" and "after" power-spectral-densities (PSD's) for the transmitted signal. The presumed PSD for the present (pure analog) condition is shown in Figure B-2. Supplement A includes discussion of the choice of the PSD in Figure B-2.

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1 While a presumption of ground conductivity is required, and the FCC's Figure M-3 presumptions have been used throughout, any differences between Figure M-3 and real world values will be true for both the before and after cases, causing the net effect of any differences to be minimal in most cases.

2 As the non-linear influence of the receiver's detector diode is not completely know, the computer analysis actually compares the SNR of the baseband at the input terminals of the detector diode. However, conceptually, it is more intuitive to think in terms of SNR at the speaker

Co-channel stations, as one would expect from the receiver response shown in Figure B-1, had the greatest effect on received interference. The reduced response of the receiver on the first-adjacent channels caused first-adjacent channel stations to have less effect on the signal-to-noise ratios ("SNRs") (for an equal signal strength) than did the co-channel stations. Because of the even further reduced response of the receiver model on the second-adjacent channels, second-adjacent channel stations had almost no ability to dominate the SNR.

Weighting factors for each channel are obtained by convolving the receiver response with the transmitter PSD. These weighting factors are derived in Supplement A.

The total noise arriving at any studied location was obtained by multiplying the signal strength of all stations contributing to the point with the appropriate channel weighting factors and power-summing the weighted contributions.

The proposed IBOC interference was determined by presuming that all existing stations transmit in the hybrid IBOC mode. The present interference was determined by presuming that all existing stations transmit with PSD in Figure B-2. The data in Figures B-3 and B-4 was obtained by subtracting the power-sum for the present case from the power-sum for the hybrid case.

Figures B-3 and B-4 represent the end result of a long and complex chain of computer models and volumes of tabular data. The value of the data contained is not immediately apparent from the brevity of the two figures.

DAYTIME SNR CHANGES

4700 of the 7272 receiving locations (65%) experience a 4 dB improvement in net SNR when all stations simultaneously convert from conventional, analog AM transmission to hybrid IBOC transmission. Figure B-3 clearly shows that all but 500 locations obtain an improvement in SNR. Of the 500 points in the rightmost histogram bar, manual examination of the data shows that the data are clustered on the low side of the range. That is, while the range of the histogram "bin" is from 0 dB to +2 dB, the majority of points are very close to 0 dB.

NIGHTTIME SNR CHANGES

Figure B-4 shows that the nighttime data has slightly more variance than does the daytime data. The majority of the data show improvements between 0 and 6 dB. As in the daytime case, the points in the 0 dB to +2 dB "bin" are clustered in the low side of the bin.

INTERPRETATION OF THE SNR DATA

The data show that the net interference received by most broadcasters will be decreased at the contours studied by a simultaneous implementation of hybrid IBOC by all stations. For those few stations which experience an increase in interference, that increase will be nearly imperceptible. According to the data, existing broadcasters should not be negatively impacted by a simultaneous implementation by all stations of hybrid IBOC.

* * * * *

Derivations

Computation of Relative Levels of 1st and 2nd Adjacent Channel Interference

The typical AM receiver rejects signals not in the immediate proximity of the carrier frequency of interest. This rejection reduces the interference that an AM radio receives from stations on adjacent channels. The exact amount of this reduction can be determined by integrating the power spectral density of the transmitting spectrum as modified by the composite receiving filter. The following equations are used to compare the relative impact of interfering signals on co-channel, 1st, and 2nd adjacent channels.

$$I_0 = \int_{-\infty}^{+\infty} PSD_{tx}(f) \cdot Filter_{rx}(f)df$$

$$I_1 = \int_{-\infty}^{+\infty} PSD_{tx}(f - 10 \cdot 10^3) \cdot Filter_{rx}(f)df$$

$$I_2 = \int_{-\infty}^{+\infty} PSD_{tx}(f - 20 \cdot 10^3) \cdot Filter_{rx}(f)df$$

where $PSD_{tx}(f)$ is the power spectral density of the transmitting station (which, in this study, is either 10 kHz or 5 kHz with the addition of the 20 kHz IBOC DAB spectrum). The $Filter_{rx}(f)$ expression represents the attenuation of the composite receiving filter (described in the previous section) versus frequency. The integrals for the expressions I_0, I_1, and I_2 allow for the comparison of total received power at the diode detector of the receiver for co-channel, 1st, and 2nd adjacent transmitters of equal carrier power. The lower and upper channel contributions are symmetrical so that 1st adjacent upper and lower channels can be assumed to have the same level of contribution (and the same is true for 2nd adjacent interferers).

These integrals allow us to assess a penalty to the interference from stations on adjacent channels and downgrade their level of interference at a receiver because of the composite filtering in typical AM receivers. These penalties are shown in Table 1. Each of the figures in Table 1 is normalized with respect to the analog broadcasting spectrum for that scenario. For example, the 5 kHz analog signal with the addition of 20 kHz IBOC DAB shows that co-channel interference is slightly higher than the transmitted analog signal power of interest (0.04 dB higher, a negligible value). This is due to the fact that the interfering signal contains both a 5kHz analog signal AND a 20 kHz IBOC DAB signal. Meanwhile, the 5kHz analog signal does not gain any power from the 20 kHz IBOC DAB broadcast.

It is important to note that the figures in Table 1 do not take into account propagation losses. Propagation losses must be added to the filtering losses before the total interference power can be computed for a geographic point in the service area of a station in this study.

Table 1: Handicapping of interfering DAB IBOC stations used in determining impact on analog reception

	Co-Channel	1st Adjacent	2nd Adjacent
Current 10 kHz broadcast spectrum	0.0 dB	-7.21 dB	-57.1 dB
5 kHz Analog + 20 kHz IBOC DAB	0.04 dB	-12.8 dB	-62.4 dB

As expected, 1st adjacent interfering stations contribute significantly less power at the receiver than co-channel interferers (and 2nd adjacent channel interferers even less than 1st). However, the FCC does not require the same level of protection between stations that are not on the same channel. To draw meaningful conclusions from this map, the current AM allocation situation must be examined using these figures.

<u>SNR at the Receiver</u>

To determine a signal-to-noise ratio for AM reception, it is necessary to find the carrier signal strength for each interfering station and the station of interest at some geographic location. Each of the interfering stations that have the same frequency are summed using the root-sum-square method (RSS); this assumes that the interfering signals are uncorrelated. This generates a composite carrier strength for 5 channels: two 2^{nd} adjacent, two 1^{st} adjacent, and the co-channel.

Before the interference due to each of these channels can be combined into a single noise metric, they must be modified by the values in Table 1 to account for the receiving filters in AM radios. Each of the interfering signals is decreased or increased by the modifier in Table 1; then, the total interference power due to each channel can be combined using the RSS method. This reduces the total interference at a geographic point to a single power metric, which can be directly compared to the signal strength at the same location. This can be used to find signal-to-noise ratio in dB, which is simply:

$$SNR = 20 \cdot \log\left(\frac{E_{signal}}{E_{noise}}\right)$$

where E_{signal} is the carrier strength of the desired signal (the station to which the AM receiver is tuned to) and E_{noise} is the combined power of all the interferers on co-channel and adjacent channels. This value can be converted to the commonly used interference to signal level metric, di/du, by inverting the sign of the SNR value.

QUALIFICATIONS

1) The study findings can be no more accurate than the input data. Several errors in the database were observed and corrected prior to the study (e.g. the coordinates for a Canadian station included a transposition in the geographic coordinates). Other, undiscovered errors are believed to still exist. However, it is not believed that individual errors will noticeably skew the findings of the study.

2) Real-world results in the near field of an interferer may differ due to receiver front-end overload. This effect is very localized and will not significantly affect the accuracy of the results of this study.

3) Different receiver designs employ different detectors and those detectors may respond to summed signals in different ways. To avoid this anomaly, the SNR's are calculated mathematically on the baseband signal at the output of the intermediate frequency (I.F.) amplifier and before the detector.

* * * *

SUPPLEMENT B - STATIONS STUDIED

						Latitude			Longitude				Time		Power (kW)		
Station #	Rank	Call	City	tat	Freq	dg	mn	sc	dg	mn	sc	Class	Zone	NIF	Day	Night	Antenna
1	86	WNTM	MOBILE	AL	710	30	43	13	88	3	34	B	C	11.1	1	1	DA-N
2	82	KARN	LITTLE ROCK	AR	920	34	46	20	92	14	45	B	C	5.206	5	5	DA-N
3	17	KIDR	PHOENIX	AZ	740	33	21	55	112	6	30	B	M	28.4	1	0.29	DA-2
4	17	KSUN	PHOENIX	AZ	1400	33	23	23	111	59	52	C	M	25	1	1	ND-U
5	4	KSFO	SAN FRANCISCO	CA	560	37	44	44	122	22	40	B	P	2.553	5	5	DA-N
6	2	KFI	LOS ANGELES	CA	640	33	52	47	118	0	47	A	P	2	50	50	ND-U
7	4	KNBR	SAN FRANCISCO	CA	680	37	32	50	122	14	0	A	P	2	50	50	ND-U
8	15	KFMB	SAN DIEGO	CA	760	32	50	33	117	1	30	B	P	5.318	5	50	DA-N
9	2	KKHJ	LOS ANGELES	CA	930	34	2	26	118	22	18	B	P	3.846	5	5	DA-N
10	2	KFWB	LOS ANGELES	CA	980	34	4	11	118	11	36	B	P	5.148	5	5	ND-U
11	84	KGEO	BAKERSFIELD	CA	1230	35	20	53	119	0	33	C	P	25	1	1	ND-U
12	2	KYPA	LOS ANGELES	CA	1230	34	2	15	118	16	35	C	P	25	1	1	ND-U
13	27	KSQR	SACRAMENTO	CA	1240	38	35	17	121	28	5	C	P	25	1	1	ND-U
14	187	KTMS	SANTA BARBARA	CA	1250	34	25	6	119	49	5	B	P	4.725	2.5	1	DA-2
15	83	KJAX	STOCKTON	CA	1280	37	58	58	121	13	46	B	P	6.868	1	1	DA-N
16	4	KEST	SAN FRANCISCO	CA	1450	37	46	41	122	23	16	C	P	25	1	1	ND-U
17	27	KFBK	SACRAMENTO	CA	1530	38	50	54	121	28	58	A	P	2	50	50	DA-2
18	84	KNZR	BAKERSFIELD	CA	1560	35	18	30	119	2	46	A	P	2	25	10	DA-N
19	22	KLZ	DENVER	CO	560	39	50	36	104	57	14	B	M	2.313	5	5	DA-1
20	22	KOA	DENVER	CO	850	39	30	22	104	45	57	A	M	2	50	50	ND-U
21	94	KRDO	COLORADO SPRI	CO	1240	38	49	42	104	50	15	C	M	25	1	1	ND-U
22	22	KKYD	DENVER	CO	1340	39	41	1	105	0	25	C	M	25	1	1	ND-U
23	114	WICC	BRIDGEPORT	CT	600	41	9	36	73	9	53	B	E	3.826	1	0.5	DA-2
24	8	WOL	WASHINGTON	DC	1450	38	54	16	77	0	25	C	E	25	1	1	ND-U
25	8	WTOP	WASHINGTON	DC	1500	39	2	30	77	2	45	A	E	2	50	50	DA-2
26	100	WONN	LAKELAND	FL	1230	28	2	23	81	57	39	C	E	25	1	1	ND-U
27	92	WMFJ	DAYTONA BEAC	FL	1450	29	13	30	81	1	30	C	E	25	1	1	ND-U
28	11	WOCN	MIAMI	FL	1450	25	50	24	80	11	20	C	E	25	1	1	ND-U
29	12	WSB	ATLANTA	GA	750	33	50	38	84	15	12	A	E	2	50	50	ND-U
30	88	WHO	DES MOINES	IA	1040	41	39	12	93	20	56	A	C	2	50	50	ND-U
31	227	KXEL	WATERLOO	IA	1540	42	10	46	92	18	15	A	C	2	50	50	DA-N
32	199	KCRG	CEDAR RAPIDS	IA	1600	41	58	21	91	32	4	B	C	3.048	5	5	DA-N
33	126	KBOI	BOISE	ID	670	43	25	44	116	19	43	B	M	5.1	50	50	DA-N
34	3	WMAQ	CHICAGO	IL	670	41	56	1	88	4	23	A	C	2	50	50	ND-U
35	3	WMVP	CHICAGO	IL	1000	41	49	4	87	59	17	A	C	2	50	50	DA-2
36	3	WSCR	CHICAGO	IL	1160	42	2	30	87	51	57	B	C	5.351	50	5	DA-2